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APPRENTICESHIP TRAINING

MOTOR MECHANIC Program

Alberta
CAREER DEVELOPMENT AND EMPLOYMENT
Apprenticeship and Trade Certification

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TABLE OF CONTENTS

The Goal of Apprenticeship Training 1
Basic Requirements 2
Credits 2
Benefits 2
Directions for Prospective Apprentices 3
Apprenticeship Route Toward Certification 4
Apprenticeship Committee Structure 5
Apprenticeship Committee Members 5
Procedures for Recommending Revision(s) to the Course Outline 7
Safety Education 8
Subjects and Time Distribution 9

COURSE OUTLINE

First Period Subjects 10
Second Period Subjects 20
Third Period Subjects 34
Fourth Period Subjects 42
Suggested Reference Materials 48
Technical Training Schools 49
Location of Apprenticeship and Trade Certification Regional Offices 49

MOTOR MECHANIC TRADE

THE GOAL OF APPRENTICESHIP TRAINING

To develop a competent tradesman who, through skill and knowledge, is capable of repair abilities required to satisfactorily service the basic as well as the technically sophisticated components of the automotive units being used today.

THE PRODUCT OF APPRENTICESHIP — a graduate who will:

★ repair, maintain and overhaul or modify motor vehicles.

★ comprehend work orders, technical bulletins and estimates, and relate the information to the job at hand.

★ interpret warranty policy in terms of service reports, component failures and analysis records.

★ when his Certificate of Proficiency has been earned, the Motor Mechanic may opt to specialize in the repairing, rebuilding and servicing of any one or more of the many assemblies of the modern motor car.

★ executive and supervisory opportunities in the automotive industry are frequently available to trained and certified mechanics with above capabilities and motivation.

★ it is advantageous for the Motor Mechanic to familiarize himself with the work experience of closely allied trades; eg. Heavy Duty Mechanic, Auto Body Mechanic, Machinist and Welder.

MOTOR MECHANIC
APPRENTICESHIP INFORMATION

Basic Requirements:

★ Indenture for 4 periods of Trade experience.

★ Attend an 8 week technical training course in all four periods.

★ Fulfill the requirements for each period including 1800 hours of work experience inclusive of time spent at the training course; successfully complete the technical training course and obtain a satisfactory employer's report.

★ Education — a minimum requirement is the completion of grade 9 or a pass on an equivalent entrance examination as prescribed by the Trade regulation.

★ Age — the minimum age for apprentices is 16 years. There is no upper age limit.

Credits:

★ Accelerated patterns of apprenticeship may be granted for related technical training and/or experience.

Benefits:

★ Apprenticeship is a learning-while-earning program. During the apprenticeship period, while working at the trade, apprentices are assured by regulation of a minimum percentage of the prevailing journeyman rate: 55% during the first period, 70% during the second period, 80% during the third period, 90% during the fourth period. Progress from one rate to the next takes place only after successful completion of all the requirements for each period. (details are outlined in the Record Book).

★ All apprentices 17 years of age and older are normally eligible for training allowances while attending technical training courses. These allowances are funded by the Canada Employment and Immigration Commission.

★ Administrative procedures establishing the amount of training allowance is complex and can vary with an individual's circumstances. Contact a local Canada Employment Centre for details.

★ An apprentice who successfully completes the program will graduate with an Alberta Completion of Apprenticeship Certificate and a Certificate of Proficiency. It is also possible for the graduate to obtain an interprovincial Red Seal by passing an additional examination and so become recognized as a qualified tradesman throughout Canada.

★ The most significant benefit to the graduate apprentice is that he is well trained in technical and practical aspects of the trade and is able to make a worthwhile and productive contribution to society. Society in return, will provide an opportunity for livelihood.

DIRECTIONS FOR PROSPECTIVE APPRENTICES

★ Contact your nearest Apprenticeship and Trade Certification office for detailed information and counselling (see list of offices on page 49).

★ Obtain an application form from the Apprenticeship and Trade Certification office and neatly complete, in full, the information requested of the apprentice.

★ Persevere in the search for apprentice employment and upon obtaining employment, give the application to the employer. It should be completed and returned to an Apprenticeship and Trade Certification office forthwith.

★ Any time credit, for previous experience in the Motor Mechanic trade, should be discussed with the employer and requested on the application form by the employer.

★ Attach to the apprentice application a copy (transcript) of the marks for your last year of school. Applicants who do not have their school transcripts or a grade 9 standing are required to write an entrance examination. If transcripts have been lost, contact Alberta Education for information on school transcripts.

★ A contract of apprenticeship is entered into between the apprentice and the employer and should be signed within 90 days after the apprentice application has been approved. If contracts have not been issued within this time, contact the Apprenticeship and Trade Certification office.

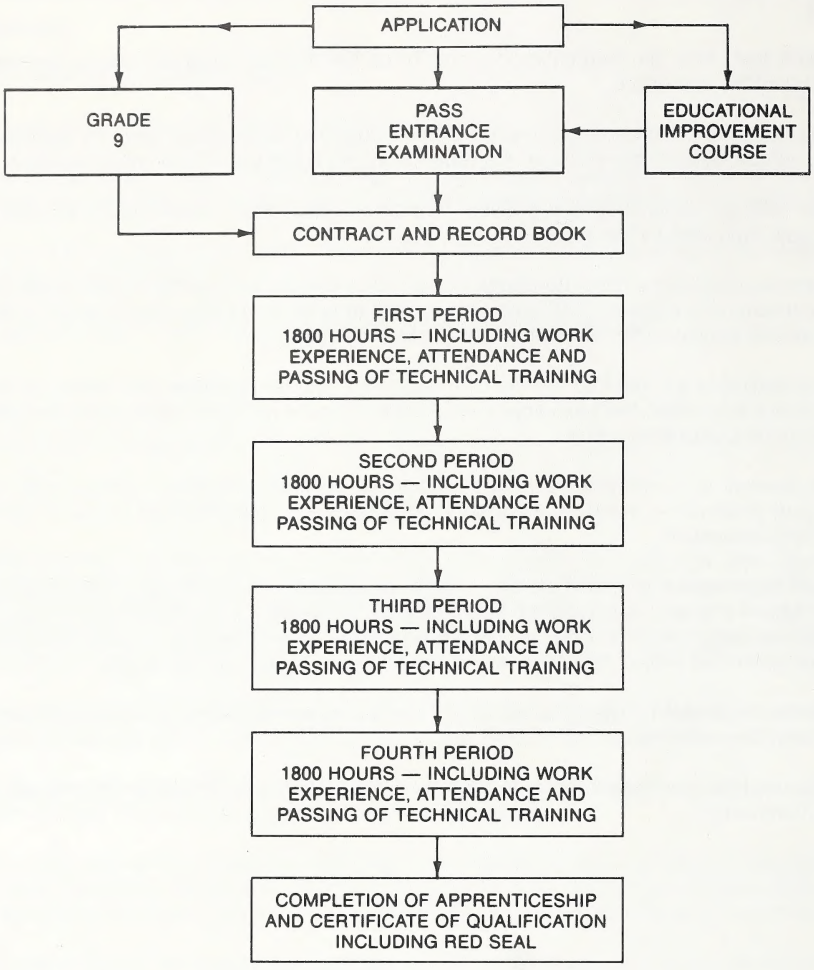
★ Before signing the contract of apprenticeship read the complete document carefully — know your obligations and responsibilities to your employer — know the employer's obligations and responsibilities to you — feel confident you have selected the right occupation.

★ Know when you will be expected to attend classes and be prepared to attend. In early May of each year, School Schedules are sent to you and your employer. The employer also receives a class selection card for you, which is to be completed and submitted for scheduling. Information on procedures also accompanies the above. Confirmation on the date you actually get scheduled and/or the Official Notice will follow at the appropriate time(s).

★ Prepare in advance for the financial obligations required of you during school training. Reference materials and school supplies are paid for by the apprentice.

★ While an apprentice, it will be your responsibility to respond promptly to mailed directions and requests from Apprenticeship and Trade Certification.

APPRENTICESHIP ROUTE TOWARD CERTIFICATION


APPLICATION
GRADE 9
PASS ENTRANCE EXAMINATION
EDUCATIONAL IMPROVEMENT COURSE
CONTRACT AND RECORD BOOK
FIRST PERIOD 1800 HOURS — INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
SECOND PERIOD 1800 HOURS — INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
THIRD PERIOD 1800 HOURS — INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
FOURTH PERIOD 1800 HOURS — INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
COMPLETION OF APPRENTICESHIP AND CERTIFICATE OF QUALIFICATION INCLUDING RED SEAL

APPRENTICESHIP COMMITTEE STRUCTURE

Motor Mechanic Provincial Apprenticeship Committee

The Provincial Apprenticeship Committee for the Motor Mechanic Trade is comprised of members from Local Apprenticeship Committees from the cities of Calgary, Edmonton, Fort McMurray, Grande Prairie, Hinton, Lethbridge, Medicine Hat, Peace River and Vermilion.

This Committee is concerned with the policies that guide the program and make recommendations to the Apprenticeship and Trade Certification Board and the Executive Director of Apprenticeship and Trade Certification in the following areas:

- ★ Contribute current information relative to changes in the trade and requirements of industry.
- ★ Make recommendations for changes to existing trade regulations.
- ★ Assist in updating of the training program through recommendations for revisions to the course outline and attendant examinations.

Motor Mechanic Local Apprenticeship Committee

Local Apprenticeship Committees are concerned with individuals and trade situations within a local region. Meetings are held throughout the year to make recommendations and to discuss problems relating to the apprenticeship program. Members who serve on committees are nominated by employer and labour organizations, and membership is equally divided into employer and employee representation in accordance with The Manpower Development Act.

Apprenticeship Committee Members:

Mr. J. Kudryk — Edmonton — Employer
Mr. M. Livingston — Edmonton — Employer
Mr. D. Bodnaruk — Edmonton — Employer (Alternate)
Mr. W. Keen — Edmonton — Employee
Mr. J. Jorgensen — Edmonton — Employee
Mr. S. Piche — Edmonton — Employee (Alternate)
Mr. W. Wilson — Calgary — Employer
Mr. R. Scott — Calgary — Employer
Mr. B. D. Hooker — Calgary — Employer (Alternate)
Mr. L. C. Bratko — Calgary — Employee
Mr. A. R. Trudeau — Calgary — Employee (Alternate)
Mr. P. Schipper — Lethbridge — Employer
Mr. D. Macaulay — Lehtbridge — Employee
Mr. J. DeJager — Lethbridge — Employee
Mr. J. Stryker — Red Deer — Employee
Mr. S. Bull — Medicine Hat — Employer
Mr. M. Kurpjuwett — Medicine Hat — Employer
Mr. R. Ashby — Medicine Hat — Employee
Mr. R. Lynde — Medicine Hat — Employee
Mr. C. F. Ross — Grande Prairie — Employer
Mr. G. C. Olson — Grande Prairie Employer (Alternate)
Mr. D. Nilsson — Grande Prairie — Employee
Mr. K. M. Leit — Grande Prairie — Employee (Alternate)
Mr. B. P. Knutsen — Fort McMurray — Employer
Mr. G. Requier — Fort McMurray — Employee
Mr. W. Mayowski Jr. — Vermilion — Employer
Mr. G. C. Webb — Vermilion — Employer (Alternate)
Mr. P. J. Howorko — Vermilion — Employee

Mr. J. H. Klasson — Vermilion — Employee (Alternate)
Mr. N. S. Sandboe — Peace River — Employer
Mr. M. Paquette — Peace River — Employer (Alternate)
Mr. M. Thiessen — Peace River — Employee
Mr. J. Johnson — Peace River — Employee (Alternate)
Mr. Z. Wojciechowski — Hinton — Employer
Mr. L. Schooley — Hinton — Employer (Alternate)
Mr. L. Ovelson — Hinton — Employee
Mr. G. Van Tighem — Hinton — Employee (Alternate)

MOTOR MECHANIC PROGRAM
COURSE OUTLINE

This outline has been prepared in accordance with recommendations from the Provincial Apprenticeship Committee for the Motor Mechanic Trade in the Province of Alberta.

The outline was updated following consideration given to recommendations and suggestions from:

Local Apprenticeship Committees
Representatives from training institutes
Curriculum Sub-Committee from the Provincial Apprenticeship Committee

PROCEDURES FOR RECOMMENDING
REVISION(S) TO THE COURSE OUTLINE

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to Apprenticeship and Trade Certification, Edmonton.

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

SAFETY EDUCATION

Safe working procedures and conditions, accident prevention and the preservation of health is of primary importance in the Apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of the government, employers, employees and the general public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm and that safe learning experiences and environment can be created by controlling the variables and behaviors that may contribute to or cause an accident and/or an injury.

It is generally recognized that a safe attitude contributes to an accident free environment. As a result a healthy safe attitude towards accidents will benefit an employee by helping to avoid injury, loss of time and loss of pay.

A tradesman is possibly exposed to more hazards than any other person in the work force and therefore, should be familiar with the Occupational Health and Safety Act and Regulations dealing with his own personal safety and the special safety rules applying to each job.

LEGAL AND ADMINISTRATIVE ASPECTS

Employer's Responsibilities:

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer. The company is responsible for:

1. The provision and maintenance of safety equipment
2. The provision of protective devices and clothing (as required by the Occupational Health & Safety Act, General Safety Regulations)
3. The enforcement of safe working procedures
4. Adequate safeguards for machinery, equipment and tools
5. Observance of all accident prevention regulations
6. Adequate training to allow a worker to use or operate equipment in an effective and safe manner.

Government's Responsibilities:

Apprenticeship and Trade Certification in conjunction with the respective Provincial Apprenticeship Committee assumes the responsibility to assure that adequate safety is reflected in the curriculum and that adequate safety instruction is presented at the training establishments.

The Occupational Health and Safety Inspection Branch assumes the responsibility for periodic inspection of the operation to ensure that regulations for industry are being correctly observed.

Individual's Responsibilities:

The employee is responsible for:

1. Knowing and working in accordance with the safety regulations pertaining to job environment and
2. Working in such a way as not to endanger himself or his fellow employees

The major factor in safety is the individual employee, his personal attitude toward safety and having an awareness of the respective safety regulation.

MOTOR MECHANIC PROGRAM

Subjects and Time Distribution

First Period	**8 Weeks**	**30 Hours Per Week**	**240 Hours**
Section One:	Basic Materials, Tools and Skills		27
Section Two:	Safe Use of Oxy-acetylene		10
Section Three:	Power Train		46
Section Four:	Suspension and Steering		91
Section Five:	Brake Systems		46
Section Six:	Electrical		20
Second Period	**8 Weeks**	**30 Hours Per Week**	**240 Hours**
Section One:	Gasoline and Diesel Engines — Theory Service Repair		158
Section Two:	Rear Axle Assemblies		54
Section Three:	Drive Lines		6
Section Four:	Basic Electrical		22
Third Period	**8 Weeks**	**30 Hours Per Week**	**240 Hours**
Section One:	Charging Systems		76
Section Two:	Cranking Systems		33
Section Three:	Ignition Systems		49
Section Four:	All Fuel Systems		54
Section Five:	Tune-Up and Accessories		28
Fourth Period	**8 Weeks**	**30 Hours Per Week**	**240 Hours**
Section One:	Automatic Transmissions		160
Section Two:	Air Conditioning		30
Section Three:	Special Options		14
Section Four:	Fuel Systems		26
Section Five:	Review		10

FIRST PERIOD TECHNICAL TRAINING
MOTOR MECHANIC
COURSE OUTLINE

SECTION ONE: **BASIC MATERIALS, TOOLS AND SKILLS** **27 HOURS**

TOPIC	COURSE OBJECTIVES
	Upon completion of this unit, the apprentice should be able to:
A. Terminology	
	1. Name standard terms used for parts, components and functions. 2. Describe operational units and characteristics of materials as applied to first period technical training. 3. Communicate using proper terminology. 4. State the value of using proper terminology.
B. Mechanical Measuring Tools	
	1. Describe and apply units of linear measurement in the Imperial and SI systems. 2. Explain the value of proper care and storage of precision measuring tools. 3. Convert decimal values to fractional values and fractional values to decimal values. 4. Demonstrate the proper use of, and explain the limitations of: (a) common calipers (b) small — hole gauges (c) telescoping gauges (d) dial indicators in Imperial and SI units (e) outside micrometers in Imperial and SI units (f) inside micrometers in Imperial and SI units (g) Vernier calipers in Imperial and SI units 5. Explain the concept of torque as related to fasteners in the Imperial and SI units. 6. Explain the use and care of the steel straightedge.
C. Hand Tools	
	1. Demonstrate the use of bolt and stud removers. 2. Explain procedures and precautions related to bolt and stud removal. 3. Demonstrate thread repair methods. 4. Perform double and SI flaring of steel tubing. 5. Identify common reamer types and explain their proper use and storage. 6. Explain how twist drills are classified, reconditioned and selected for common drilling operations. 7. Recognize common drilling faults and causes. 8. Explain the classification system for common taps and dies. 9. Define common taps and dies by size, thread characteristics and use. 10. Specify correct threading lubricants, procedures and precautions.

TOPIC	COURSE OBJECTIVES
D. Fastening Devices	
	1. Explain bolt, nut, capscrew, machine screw and stud classifications according to strength of material, size, length, thread and head type in Imperial and SI units.
	2. Describe common nut types with self-locking features.
	3. Explain recommended torquing methods for threaded fasteners.
	4. Explain reasons for cleaning and lubricating threads before torquing.
	5. Demonstrate the repairing of slightly damaged threads.
	6. Explain the function and use of splines, keys, set screws and snap rings.
	7. Explain types and application of adhesives and sealers.
E. Safety	
	1. Explain that electric power tools must be grounded or double insulated and in good working order for safe use.
	2. Explain how flammable liquids and gases are to be handled and stored in a safe manner.
	3. Explain how fire extinguishers are classified and recommended for use as well as how to use them.
	4. Explain the proper method for storing oil soaked rags.
	5. Demonstrate recommended methods for handling and charging lead — acid type storage batteries.
F. Canada Manpower and Immigration	
	1. The function of the Department.
	2. How to apply for benefits under the Federal Act.
	3. The conditions for receiving benefits.
	4. How the service is provided.
G. Occupational Health and Safety	
	1. The function and purpose of the Branch.
	2. How contributions are made.
	3. The conditions governing the Branch.
	4. The coverage provided by the Branch.
H. Apprenticeship and Trade Certification Branch	
	1. The role and function of the Branch.
	2. The organizational pattern of the Branch.
	3. The provisions provided for receiving input from management and labour.

TOPIC	COURSE OBJECTIVES

SECTION TWO: SAFE USE OF OXY-ACETYLENE EQUIPMENT **10 HOURS**

A. Gas Heating and Cutting

1. Explain the characteristics of oxygen and acetylene and know the recommended handling methods for same.
2. Identify the respective cylinders and fittings by colour, thread design and sizes.
3. Explain the design of the cylinders and how these are to be handled and stored.
4. Recognize the construction and function of regulators and hoses.
5. Explain handling precautions for regulators and hoses.
6. Detect gas leaks and know how to correct such leaks.
7. Explain the construction and function of the torch and tips.
8. Demonstrate how to clean, store and take care of torch tips.
9. Explain torch malfunctions and how to correct same.
10. Select the attachments required for cutting and know the required safety precautions to be taken.
11. Explain the basic cutting operation.
12. Explain the use of eye and face protective equipment required as well as the need for fire extinguishers.

SECTION THREE: POWER TRAIN **46 HOURS**

A. Clutch **15 Hours**

1. Identify the purpose of the clutch and the types in common use today.
2. Name all the clutch parts, function and composition of disc friction material.
3. Name, in correct order, all parts that transmit power from the flywheel to the clutch shaft.
4. Explain the movements of the release mechanism and pressure plate when the clutch is released or engaged and the effect of their adjustments.
5. Identify the design features and understand the purpose of:
   (a) those parts which absorb torsional shock
   (b) those parts which cushion clutch engagement
   (c) controlling heat dissipation
6. Identify and describe the checks for clutch disc, pressure plate, flywheel and the release and pilot bearings.
7. Identify and describe the dial indicator checks for bore and face runout and specify the tolerances and methods of correction.
8. Identify the types of release bearings, methods of their service and adjustments of:
   (a) pedal height
   (b) total pedal travel
   (c) free travel
9. Describe the installation procedure noting:
   (a) cleanliness of all parts
   (b) correct disc placement
   (c) clutch alignment
   (d) lubrication of bearings and linkages

TOPIC	COURSE OBJECTIVES
	10. Describe hydraulic clutch operation, noting the advantages and disadvantages as related to the mechanical system. 11. Identify the cause or causes when given a typical clutch problem and describe the procedure of correction.
B. Transmission	**27 Hours**
	1. Identify the main purposes of a manual transmission. 2. Describe the effect on speed and torque when the drive gear is: (a) smaller than the driven (b) larger than the driven 3. Refer to all major parts by their correct names, and supply alternate part names where applicable. 4. Name in correct order, all the part names that transmit power from the input shaft to the output shaft for each of the driving ranges in a sliding gear and/or constant mesh synchromesh transmission. 5. Describe the operation of synchromesh units commonly used in transmissions. 6. Calculate to two decimal places, the forward and reverse ratios of any given transmission, using gear teeth data. 7. Identify by cut of teeth, two gear designs commonly used in manual transmissions and state the advantages and disadvantages of each. 8. Explain the purpose and operation of detent and interlock mechanisms of standard transmissions. 9. (a) Identify methods used by the manufacturer to lubricate the working parts of a transmission. i.e.: bearings, gears, shaft, bushings, etc. (b) State the types of lube used in standard transmissions. 10. Describe the disassembly procedure noting precautions in the service manual. 11. Describe the inspection of all disassembled parts. 12. Describe the assembly checks and procedures to follow. 13. Describe the linkage adjustments and identify, from a problem given, the method of correction. 14. Identify the cause or causes when a typical transmission problem is described and state the procedure of correction. 15. Explain the purpose and operation of transaxles commonly used. 16. Explain the purpose and operation of transfer cases commonly used. 17. To disassemble and reassemble a manual transmission using a shop manual.
C. Axle	**4 Hours**
	1. Identify axle types. 2. Explain operating principles. 3. Identify axle retaining methods. 4. Adjust axle end play. 5. Replace axle seals and bearings.

TOPIC	COURSE OBJECTIVES
SECTION FOUR:	**SUSPENSION AND STEERING** **91 HOURS**
A. Steering — Frames	**3 Hours**
	1. State the function of the frame. 2. Name several major components supported by or attached to the frame. 3. Identify different types of frame construction. 4. Describe the design features of the different types of frames including unibody. 5. Describe frame checking and straightening procedures. 6. Identify and name the frame alignment checking equipment.
B. Suspension Systems	**14 Hours**
	1. Name all the suspension parts, and state their functions. 2. Describe the checking procedures for indicating wear in all suspension parts. 3. Describe and demonstrate the correct procedure for removal and installation of all suspension parts. 4. Define the terms "sprung" and "unsprung" weight, and list their advantages and disadvantages. 5. Describe the operation of air suspension.
C. Wheels, Hubs, Tires	**10 Hours**
	1. Name and identify the common types of wheels used on modern day automobiles. 2. Explain the construction features of different wheels. 3. Identify wheel dimensions. 4. Give common methods of attaching wheels to the hubs. 5. State correct torquing procedure for wheel fasteners. 6. Name and identify the common types of hub arrangements used on modern day automobiles. 7. Name the types of bearings used on front hubs. 8. Describe the proper cleaning and checking procedure for wheel bearings. 9. Demonstrate the proper lubrication methods for bearings. 10. Demonstrate the correct method of wheel bearing installation and bearing adjustment. 11. Explain how front and rear wheel hubs are retained on the vehicle. 12. Name different types of tire construction design in common use. 13. Describe tire sizing, and load ratings. 14. Give some examples of popular tire sizes. 15. State the recommended procedures for rotating tires. 16. Demonstrate proper methods of checking for, and identifying tire faults. 17. Describe proper mounting and dismounting procedures for all tire types. 18. Give proper method of checking and establishing proper air pressure. 19. Describe the importance of wheel alignment relative to tire mileage.

TOPIC	COURSE OBJECTIVES
	20. Name the conditions that vary in relation to normal tire wear. 21. Describe and identify worn parts, causing tire wear. 22. List the conditions that cause abnormal tire wear. 23. Explain static and dynamic unbalance and the method used to correct. 24. Identify unbalance conditions by using a wheel spinner. 25. Describe the procedure and balance wheels on the car. 26. Describe the procedure and balance wheels off the car. 27. Discuss the pros and cons of different balancing machines.
D. Steering Gears (Manual)	**8 Hours**
	1. Name and identify the different types of manual steering gears. 2. List all part names and their location. 3. Describe different design and construction features of all manual steering gears. 4. Describe the procedure of disassembly, inspection and reassembly. 5. Describe proper adjustment procedure, on and off the car. 6. Describe the results of faulty or improperly adjusted steering gears. 7. Explain proper lubricant application and filling procedures.
E. Power Steering	**14 Hours**
	1. Describe the advantages and disadvantages of power steering. 2. Name and identify linkage, integral and rack and pinion type of power steering. 3. Name the type of pumps as vane, roller and slipper and identify the location of the control valves. 4. Refer to all major parts by their correct names, and supply alternate part names where applicable. 5. Describe and demonstrate bearing and overcentre preloads, on car and off car. 6. Describe the installation of pressure gauge and state the high and low readings. 7. Describe proper parts check procedure. 8. Describe disassembly, and assembly of power steering unit.

TOPIC	COURSE OBJECTIVES
F. Steering Angles	**15 Hours**
	1. Identify the wheel alignment angles and describe the relationship and characteristics of: (a) caster (b) camber (c) steering axis inclination (d) turning radius (e) toe-in, toe-out 2. Describe the function, action and effects of each steering angle to the vehicle handling. 3. Describe how all alignment angles are measured. 4. Describe different methods of adjusting wheel alignment angles.
G. Alignment Procedure	**18 Hours**
	1. Describe and demonstrate the correct procedure of checking and adjusting all alignment angles. 2. Identify and calculate the angles measured in degrees, fractions, minutes and millimetres. 3. Describe how to select caster settings according to guidelines. 4. Describe how to select camber settings according to guidelines. 5. Do "alignment" exercises in classroom (two and four wheel). 6. Describe and adjust the alignment angles according to the given guidelines. 7. Identify the steering gear hi-spot: (a) with front wheels in the straight ahead position (b) with steering wheel centered 8. Describe the proper methods and procedures necessary to center the steering wheel.
H. Problem Diagnosis	**9 Hours**
	1. Identify the cause or causes when given a typical steering problem and describe the procedure of correction.
SECTION FIVE:	**BRAKE SYSTEMS** **46 HOURS**
A. Master and Wheel Cylinders	**10 Hours**
	1. State Pascal's Law. 2. (a) Describe the advantages and disadvantages of small cylinders versus large cylinders in relation to pressures required. (b) Explain the terms: (i) coefficient of friction (ii) kinetic energy 3. Name the types of master cylinders. 4. Name four types of wheel cylinders as: (a) equal bore (b) stepbore (c) single piston (d) caliper 5. Refer to all major parts by their correct names for master cylinder and wheel cylinder.

TOPIC	COURSE OBJECTIVES
	6. Describe the operation of both master and wheel cylinders during: (a) released position (b) applying position (c) releasing position 7. Describe the reconditioning procedure noting: (a) bleeder screws for being free and open (b) clearance between piston and cylinder (c) replacement of parts (d) when pitting demands cylinder replacement 8. Describe the final checks and adjustments to master and wheel cylinders. 9. List the shop safety precautions for a vehicle with poor or no brakes.
B. Lines, Fluids and Bleeding	**4 Hours**
	1. Identify the two types of brakes lines as: (a) steel tubing (b) flexible hose 2. List the reasons for using steel and flex lines and explain methods used to protect these lines when installed on the vehicle. 3. Name the type of fittings required for steel brake lines and demonstrate the forming of a double flare to the satisfaction of the instructor. 4. Name the types of brake fluids used and describe their limitations. 5. List characteristics of brake fluid. 6. State the precautions required when handling brake fluid. 7. Describe and demonstrate, the three methods of bleeding: (a) manual (b) pressure (c) surge 8. State the two functions of brake fluid. 9. State the procedure used to bleed disc brakes equipped with a metering valve.
C. Drum Brakes	**5 Hours**
	1. List the types of brake drum construction and materials used. 2. State the two functions of a brake drum: (a) frictional surface (b) dissipate heat 3. List four brake drum checks. 4. Demonstrate in shop the method of drum turning and list the specifications of turning to the satisfaction of the instructor. 5. Explain the method of drum grinding and state its purpose to the satisfaction of the instructor. 6. State the purpose of the backing plate used with a drum brake system. 7. State the purpose and check condition of the platforms on the backing plate.

TOPIC	COURSE OBJECTIVES
D. Shoe Arrangement Materials and Grinding	**4 Hours**
	1. State and show the parts of a typical brake shoe: (a) web (b) platform (c) heel and toe 2. Name ingredients of which brake linings are made. 3. Explain the term "metallic" as it applies to brake linings. 4. List the properties and reasons for primary and secondary lining. 5. Describe the checks made to lining to determine if replacement is required. 6. Describe the two methods of attaching linings and give advantages of each. 7. Discuss cam and concentric grinding procedures and explain hazards of brake dust. 8. Identify the various brake shoe arrangements when shown examples. 9. Identify and describe the adjustment and service procedures following a brake system reconditioning.
E. Disc Brakes	**9 Hours**
	1. State advantages and disadvantage of disc brakes over drum brakes. 2. Name the two types of disc brake assemblies used. 3. Name the types of rotors used. 4. Describe the operation of the two types: (a) fixed caliper (b) floating caliper during released and applied positions 5. Explain how disc pads are self adjusted. 6. List the checks and service operations required during brake reconditioning. 7. Demonstrate in shop, the turning and the specifications of a disc brake rotor to the satisfaction of an instructor. 8. Demonstrate in shop, the disassembly, repair and assembly of a caliper to the satisfaction of an instructor. 9. Demonstrate pad removal when equipped with rear disc brakes.
F. Brake Valves and Park Brakes	**9 Hours**
	1. Name the two special valves used with a combination disc and drum system. 2. Name the valve used with tandem split systems. 3. State the function of: (a) metering valve (b) proportioning valve (c) pressure differential valve 4. Give the location and type of park brake used with: (a) drum brakes (b) four wheel disc brakes 5. State the proper order and correct procedure for adjusting cable actuated park brake.

TOPIC	COURSE OBJECTIVES
G. Power Brakes	**5 Hours**
	1. Name the three types of power brake units. 2. List the valves and their positions while: (a) released (b) applied (c) holding for both the atmospheric and vacuum units 3. List in order the hydraulic flow from power steering pump back to reservoir in a hydro-boost unit. 4. Describe the operation of both the atmospheric and vacuum suspended units for: (a) released (b) applied (c) holding positions 5. Describe how malfunctions affect power brake operation and list the service procedures for correction of the malfunction. 6. List the hydro-boost problems and describe the procedure for bleeding the system. 7. Describe how to check a power brake for operation. 8. List the purpose of the vacuum pump.
SECTION SIX: **ELECTRICAL**	**20 HOURS**
A. Introduction to Electrical Systems	
	1. Identify simple series, parallel and series-parallel circuits. 2. Explain characteristics of voltage, current and resistance related to simple circuits. 3. Identify shorts, opens and grounds in simple circuits. 4. Explain the use of voltmeter, ammeter and ohmmeter in testing simple circuits. 5. Explain the use of test lights (powered and non-powered) in tracing simple circuits. 6. Explain in simple terms the construction and operation of the lead-acid type storage battery. 7. Explain the classification systems for storage batteries. 8. Perform recommended battery test operations. 9. Perform recommended battery service. 10. Connect batteries to fast and line chargers. 11. Connect batteries for boosting from other batteries. 12. Explain simple electrical diagrams. 13. Explain the effect of excessive resistance in cables and connections. 14. Use the voltmeter for detecting high resistance at electrical connections.

SECOND PERIOD TECHNICAL TRAINING
MOTOR MECHANIC
COURSE OUTLINE

SECTION ONE: **GASOLINE AND DIESEL ENGINES THEORY, SERVICE AND REPAIR** **158 HOURS**

TOPIC	COURSE OBJECTIVES
	Upon completion of this unit, the apprentice should be able to:
A. Engines	**20 Hours**
	1. Explain the stages of development of the internal combustion engine. 2. Explain the principles of operation in relation to: (a) torque (b) bore (c) stroke (d) engine displacement (e) compression ratio 3. Identify the different classifications of engines as to: (a) design of cylinder arrangement (b) different cooling methods (c) strokes per cycle (two and four) (d) valve arrangement (e) induction method (f) type of fuel 4. Identify and explain engine operation: (a) four cycle (b) two cycle 5. Compare gasoline engines to diesel engines as to: (a) type of fuel (b) compression pressure and temperature (c) ignition of fuel charge
B. Engine Components	**63 Hours**
1. Engine Cylinder Block	1. Identify the different materials used in cylinder blocks: (a) cast iron (b) aluminum 2. Explain the relationship of materials to heat and friction. 3. Explain the purpose of a cylinder block: (a) serves as foundation for all engine parts 4. State the purpose of sleeves and liners: (a) integral cylinder (b) cast iron liner 5. State the methods of measuring a cylinder for: (a) taper (b) out of round (c) oversize 6. Explain the procedure employed in deglazing a cylinder. 7. Explain the procedure used to hone a worn cylinder: (a) proper cross hatch (b) micro inch finish (c) grit of stone used (d) taper and out of round control

TOPIC	COURSE OBJECTIVES
	8. Explain the procedure used to rebore a cylinder: (a) typical oversizes (b) boring bar mounting precautions (c) bore to piston size — hone the clearance (d) how to determine an oversize 9. Explain the procedure to inspect and test a complete cylinder block for: (a) cracks (dye, magnetic particle, pressure test) (b) warpage (c) wear (d) open or blocked passages
2. Cylinder Liners	1. Identify different types of liners: (a) wet (b) dry
3. Piston and Piston Rings	1. Specify the function of the piston: (a) transmit thrust (b) assist in sealing combustion (c) aid in creating turbulence (d) dissipate heat 2. State the materials used in relation to expansion and heat control: (a) cast iron (b) aluminum 3. Identify and state the function of special piston characteristics: (a) heat dam (b) cam ground piston (c) tapered piston (d) vertical slots (e) horizontal slots (f) slipper piston (g) knurling 4. State the methods of piston lubrication and cooling: (a) spray (b) splash 5. Demonstrate proper measuring techniques with respect to: (a) accurate piston size (b) oversize determination (c) clearances 6. State a reconditioning procedure including: (a) cleaning (b) measuring ring clearance (c) wrist pin clearance (d) skirt clearance 7. State the three pin retaining methods. 8. State a proper pin fit for a specified pin. 9. Specify the function of piston rings and location: (a) seal combustion and compression (b) control oil (c) transfer heat 10. State the construction of rings and material used: (a) rectangular (b) tapered face (c) inside bevel (d) barrel face (e) step joint (f) angle joint

TOPIC	COURSE OBJECTIVES
	(g) butt joint (h) cast iron (i) chrome plated (j) molybdenum (k) stainless steel (l) reverse torsional twist
	11. Install rings onto a piston properly observing all precautions: (a) ring expanders (b) ring location (c) lubrication
	12. Measure and fit piston rings to piston and cylinder with reference to: (a) ring to land clearance (b) end gap (c) oversize cylinder
	13. Identify and properly install segmented or one piece oil ring.
	14. Demonstrate installation of the piston into the engine: (a) proper ring staggering (b) lubrication (c) ring compressor (d) bolt boots (e) rod torqued to shaft
4. Connecting Rods	1. Explain the function of the connecting rod.
	2. State the material and process in manufacture of a connecting rod.
	3. Identify different types of rods: (a) by the type of pin
	4. State the pin clearance or interference fit in the small end of the rod.
	5. State the materials used in bearing construction: (a) insert backing material (b) bearing materials (c) methods of applying bearing material to the backing
	6. Identify methods of lubricating connecting rod bearings: (a) oil holes in inserts (b) oil passage drilled in rod (c) spit hole in rod (d) connecting rod throw off oil
	7. State seven (7) bearing insert characteristics: (a) conductivity (b) fatigue resistance (c) anti scuffing (d) conformability (e) imbedability (f) load carrying capacity (g) anti corrosion ability
	8. Explain crush and spread and their purpose.
	9. Demonstrate the procedure in resizing a connecting rod big end.
	10. Demonstrate the procedure in straightening a rod: (a) bends (b) twists
	11. Explain how a rod is balanced to the engine.
5. Crankshaft	1. Describe the function of the crankshaft.
	2. Distinguish between the designs of different crankshafts for different engine designs.

TOPIC	COURSE OBJECTIVES
	3. Explain the relationship of firing order and running order. 4. State the different materials and method of crankshaft manufacture and service. 5. Describe the process used to balance a crankshaft: (a) internal balance (b) external balance 6. Name six major crankshaft parts: (a) main journal (b) rod journal (c) counterweight (d) web (e) cheek (f) oil slinger 7. Evaluate the condition of the shaft from the standard measurements: (a) journal size (b) out of round (c) taper (d) thrust bearing surfaces (e) fillet radius condition (f) straightness (g) crack detection 8. Describe crankshaft lubrication provisions: (a) oil fed to rod throw from main journal 9. Demonstrate proper crankshaft installation, including: (a) cleanliness (b) lubrication (c) thrust bearing protection (d) plastigage (e) thrust main alignment (f) proper torque 10. Demonstrate a crankshaft end play measurement. 11. State the function of the engine flywheel.
6. Balances, Dampers and Counterweights	1. Describe the different means of balancing and relate the different balancing components: (a) flywheel (b) vibration dampers (c) auxiliary balance shafts (d) crankshaft counterweights 2. Demonstrate proper installation and service procedure of a harmonic balancer.
7. Camshaft	1. Describe the functions of the camshaft: (a) speed relationship to crankshaft (b) opens valve and determines closing rate 2. Compare the design features of "in block" or "overhead" design. 3. Describe the use of the cam as a drive: (a) distributor (b) oil pump (c) fuel pump 4. State the names of the camshaft parts. 5. State the names of the lobe parts.

TOPIC	COURSE OBJECTIVES
	6. Interpret a valve timing diagram: (a) lead (b) lag (c) overlap (d) duration
	7. Recognize a worn cam lobe: (a) by visual inspection (b) by measurement
	8. Measure a camshaft journal for wear.
	9. Demonstrate the proper removal and installation of cam bearings.
	10. Diagnose badly worn cam bearings by an oil pressure loss.
	11. Describe camshaft repair procedures.
8. Valve Train and Assemblies	1. Describe the operation of several different value trains: (a) overhead valves (b) overhead cam (c) dual overhead cam
	2. Recognize the function and adjustment of the valve.
	3. Describe the heat transfer method employed by the valve.
	4. State clearance differences between inlet and exhaust due to heat: (a) guide (b) valve lash
	5. Describe different types of guides.
	6. Perform a guide replacement on an integral or insert type guide.
	7. Describe the action of a release type or positive type rotator.
	8. Perform a series of tests to determine if a valve spring is still serviceable.
	9. Describe the operation of hydraulic lifters.
	10. State the interaction of the cam lobe with the lifter base and the design features built in.
	11. Test a hydraulic lifter.
	12. Measure to determine if a lifter is worn out.
	13. Describe the function of valve seals.
	14. Demonstrate installation of valve seals: (a) different lengths inlet and exhaust (b) special protectors (c) positive seals (d) O ring types
	15. Demonstrate valve reconditioning: (a) proper use of a spring compressor (b) deburring the valve stem (c) steam wear (d) refacing (e) recondition stem end (f) inspection (g) stem height
	16. Describe the method of replacing a valve seat insert.
	17. Demonstrate proper installation of the valve.
	18. Demonstrate the proper positioning of the valve contact by grinding the seat.

TOPIC	COURSE OBJECTIVES
	19. Describe how to recondition rocker arms. 20. Describe different methods of lubricating the valve train: (a) camshaft metering (b) restricted oil flow (c) push rod oiling
9. Cylinder Head	1. State the function of a cylinder head. 2. Recognize the materials a head is made of: (a) cast iron (b) aluminum 3. State the purpose in different combustion chamber designs. 4. Discuss construction characteristics in cylinder head design: (a) coolant passages (b) coolant nozzles (c) inlet and exhaust ports 5. Demonstrate removal procedures and precautions: (a) engine cool (b) properly drained (c) loosening sequence (d) proper storage 6. Explain proper testing procedure for head: (a) cracks (i) visual inspection (ii) magnetic particle (iii) dye check (iv) pressure check (b) warpage (i) straight edge (c) stoppages (d) damage to combustion chambers 7. Recognize the reason for valve failure: (a) worn valve guide (b) fatigue failure (c) heat failure (d) erosion (e) preignition (f) insufficient tappet clearance (g) deposit on seat (h) valve seat distortion (i) lean mixture and late timing 8. Properly take measurements pertaining to the following: (a) inside guide diameter (b) guide protrusion (c) diameter of valve seat (d) width of valve seat (e) margin width 9. Repair a worn valve guide: (a) core the guide (b) knurl and ream (c) ream to oversize (d) sleeve with bronze 10. Describe the proper removal and installation of valve seat inserts. 11. Properly assemble the cylinder head with reference to: (a) cleaning of cuttings and grindings (b) lubrication

TOPIC	COURSE OBJECTIVES
	(c) correct installation of valves (d) correct installation of stem seals
	12. Properly install the head gasket with regard for: (a) front and top of gasket (b) gasket positioning (c) use of a sealer (d) block and head surface condition
	13. Torque the head in the proper sequence and stages.
10. Combustion Chambers	1. State the purpose of the combustion chamber.
	2. Recognize and state the function of: (a) open combustion chamber (b) pre combustion chamber (c) energy cell
	3. Describe the application of: (a) open combustion chamber (b) pre combustion chamber (c) energy cell
	4. Demonstrate removal and installation techniques involved with: (a) energy cells (b) pre combustion chambers
C. Engine Systems	**6 Hours**
1. Induction Systems	1. Recognize a naturally aspirated engine.
	2. Describe the function of the intake manifold.
	3. Describe different styles of intake manifold with regard to: (a) engine design (b) performance
	4. Recognize the relationship of air flow to manifold design.
	5. Demonstrate installation procedure of a manifold.
	6. Diagnose an engine problem resulting from a leak in the induction system.
2. Turbo Charger	1. State the operating principles involved in turbo charging.
	2. State the names of the parts of the turbo charger.
	3. Recognize the precautions involved in servicing the turbo charger.
	4. State the need for proper maintenance and describe what is necessary.
3. Air Cleaner	1. Describe the common types of air cleaners: (a) oil bath (b) dry element
	2. Describe the function of each type of air cleaner.
	3. Demonstrate proper maintenance procedures for each air cleaner.
D. Lubrication Systems	**12 Hours**
1. Oils	1. Describe the functions of oil: (a) lubricant (b) clean (c) cool (d) seal (e) absorb shock

TOPIC	COURSE OBJECTIVES
	2. Define the following: (a) viscosity (b) viscosity index (c) pour point (d) inhibitors (e) detergents (f) dispersants (g) S.A.E. (h) A.P.I. 3. Describe characteristics of: (a) single viscosity (b) multi viscosity
2. Oiling System	1. Describe the three basic lubrication systems: (a) splash (b) splash and pump (c) full pressure 2. Describe the full flow and partial flow filter systems. 3. Demonstrate servicing of the full flow filter system. 4. Describe the operation of oil pumps: (a) rotor (b) gear 5. Perform service checks on oil pumps: (a) rotor (b) gear 6. Describe the operation of the lubrication system valving: (a) pressure regulating valve (b) filter by-pass valve (c) check valve (d) pick up screen by-pass 7. State the purpose of an oil cooler. 8. Detect the causes of: (a) low oil pressure (b) high oil pressure 9. Describe the use of an oil analysis as a diagnostic tool.

TOPIC	COURSE OBJECTIVES
E. Cooling Systems	**12 Hours**
1. Liquid Cooling System	1. Describe the functions of the cooling system: (a) control engine temperature (b) remove excess heat 2. Describe the physical principles involved in the operation of the liquid cooling system. 3. Relate the effect of pressure on the coolant with regard to boiling point. 4. Recognize heat transfer qualities of different metals. 5. Explain the working sequence of a cooling system equipped with a thermatic fan, thermostat and shutters. 6. Describe the function and designs of common radiators. 7. Describe the construction of radiator hoses and where they are used. 8. Inspect hoses and determine if replacement is necessary. 9. Explain the operating principle involved in the water pump. 10. Describe the function of distribution tubes and nozzle. 11. Properly test a thermostat. 12. Explain the function of coolant in the coolant system. 13. Explain the properties of different coolants: (a) glycol base antifreeze (b) mixture strength (c) aluminium compatible 14. Describe the operation and testing of temperature indicators. 15. Describe the effect of a pressure cap on the system. 16. Test a pressure cap and evaluate its worth. 17. Explain the proper procedure for reverse flushing the: (a) engine (b) radiator (c) heater
2. Air Cooling Systems	1. Describe the principle of operation employed in the air cooling system. 2. Compare and contrast the air cooling and liquid cooling systems. 3. Describe the thermostat operation.
3. Air Circulating Fans	1. Describe basic fan blade design: (a) off set blades (b) variable pitch 2. Explain the function of the radiator shroud and precautions necessary for proper operation. 3. Describe the purposes for variable speed or intermittent fan operation: (a) thermo viscous (b) fluid drive (c) electric fans
F. Crankcase Ventilation	**3 Hours**
	1. Describe the operation of the ventilation systems. 2. State the necessity of the P.C.V. system with regard to: (a) pollution (b) engine operation (c) fuel-air ratio 3. Test and diagnose a P.C.V. system problem.

TOPIC	COURSE OBJECTIVES
G. Exhaust Systems	**6 Hours**
	1. Outline the function of the exhaust system. 2. Note the desired design characteristics and relate these to engine performance. 3. Recognize the use of mufflers and resonators in the system. 4. Discuss proper removal and installation procedures. 5. Recognize the need for insulators, isolators, and expansion devices as part of the installation. 6. Explain and demonstrate the need for venting the exhaust system to the outside.
H. Starting Aids	**3 Hours**
	1. State the common starting aids: (a) coolant heaters (b) oil heaters (c) starting fluid (d) glow plugs 2. Describe the operation of block type coolant heaters. 3. Describe the operation of recirculating type coolant heaters. 4. Describe the purpose and operation of glow plugs in diesel engines. 5. Describe the use and precautions when using starting fluid.
I. Emission Control	**6 Hours**
	1. State the basic problems with the control of: (a) oxides of nitrogen (b) carbon monoxide (c) hydrocarbons (d) particulants 2. State the purpose of: (a) catalytic converter (b) E.G.R. system (c) P.C.V. system (d) air injection
J. Repair Procedures	**21 Hours**
	1. Diagnose engine failures. 2. Describe engine diagnostic procedures. 3. State procedures for disconnecting electronic components, fuel delivery systems, and accessory components. 4. Describe in detail a proper disassembly and assembly procedure on a common engine. 5. Demonstrate a safe and logical method of lifting an engine into or out of a vehicle. 6. Demonstrate an understanding of written instruction: (a) school handout material (b) service manuals (c) specification sheets

TOPIC	COURSE OBJECTIVES
K. Fuel and Induction Systems	**6 Hours**
	1. Recognize engine differences that would identify a type of fuel used: (a) propane (b) diesel (c) gasoline
	2. State the seven carburetor circuits: (a) float (b) idle (c) transition (d) high speed (e) choke (f) accelerator (g) power
	3. State the purpose and operation of each circuit.
	4. Describe the operation of the heat riser valve.
	5. Describe the purpose of the heat riser valve.
	6. Contrast the E.F.E. system with the heat riser system.
SECTION TWO:	**REAR AXLE ASSEMBLIES** **54 HOURS**
A. Rear Axles and Differentials	
1. Rear Axle Types	1. Name the three types of rear axle design: (a) semi floating (b) three quarter floating (c) full floating
	2. Identify each axle by its relation to: (a) number of and type of bearings used (b) location of the bearing in relation to the axle housing (c) function of the axle shaft (d) function of the wheel bearing (e) function of the axle housing (f) method used to retain the axle in the housing (g) method of lubricating the bearing
	3. Identify location of end play adjuster or shim.
	4. Identify axle end play spacer block or shaft.
	5. Identify bearing retainer plates and collars.
2. Principles of Operation	1. State the purpose of the differential.
	2. Refer to all the major parts by their correct names.
	3. Name the three common ring and pinion gears and identify them from samples: (a) spur bevel (b) spiral bevel (c) hypoid
	4. Specify the advantage or disadvantage of each type of gear set with reference to: (a) strength (b) quiet operation (c) wiping action
3. Ratios	1. Calculate the ratio of ring gear and pinion from the number of teeth on each, and from that ratio state whether the gear set is hunting, partial hunting or non hunting.

TOPIC	COURSE OBJECTIVES
	2. State which of these gear sets should have timing marks.
	3. State what problems may be caused by failure to time these gears.
4. Pinion	1. Identify the pinion as overhung or straddle, according to the number of bearings and position of bearings.
5. Preloading Tapered Roller Bearings	1. Name stages in the process of preloading tapered roller bearings.
	2. State the reasons for preloading tapered roller bearings.
	3. State why new and used bearings are preloaded differently.
	4. Name three ways to measure preload.
	5. State the function of the crush sleeve between the pinion bearings.
	6. Perform accurate preload adjustments.
6. Path of Power	1. Trace the path of power from the driven pinion to the axle.
7. Describe Differential Action Under a Variety of Driving Conditions	1. Find a differential gear ratio when given the number of revolutions of one wheel and the drive shaft.
	2. Find the speed of one free wheel relative to the speedometer.
	3. Find the R.P.M. of one wheel when given the speed of the other wheel and ring gear.
	4. Find the speed of the ring gear when the speed of both wheels is known.
8. Find the Torque at the Wheels When the Torque at the Ring Gear is Known	1. Find the torque at the ring gear when given the torque at one wheel.
9. Pinion Position Shim Selection	1. State the concept of nominal pinion depth.
	2. State the purpose of the depth markings on the pinion.
	3. State the relationship between the machining of the carrier and nominal depth.
	4. Describe the function of the pinion depth tool to check carrier machining.
	5. Describe the different calculations involved in a straddle or overhung type pinion.
10. Tooth Contact	1. Describe the construction of a ring gear tooth and state: (a) drive side (b) coast side (c) heel (d) toe (e) face (f) flank (g) pitch line
	2. Describe the change in gear contact: (a) when the backlash is changed (b) when the pinion depth is changed
11. Differential Inspection	1. Inspect differential bearings and determine if they can be reused.
12. Differential Lubricant	1. State the type of lubricant used in a differential.
	2. Describe the flow of lubricant to the different bearings in the differential.
	3. Replace axle and pinion seals properly.
13. Double Reduction Differential	1. Describe the operation of a double reduction differential unit: (a) single speed (b) two speed

TOPIC	COURSE OBJECTIVES
14. Two Speed Differential	1. Describe the operation of a two speed single reduction: (a) name the parts of a planetary gear set (b) name the parts of the planetary set that are integral with the ring gear and the differential case (c) name the input, output and reactionary members in reduction (d) name the two planetary members locked together to produce high (e) disassemble and assemble and adjust a two speed differential
15. Road Test	1. Describe four road test conditions with respect to load: (a) drive (b) coast (c) cruise (d) float 2. Identify a bearing condition as distinct from a gear noise. 3. State that as the torque is increased the pattern moves out on the tooth. 4. Check all preroad test items before road testing vehicle.
16. Positive Traction Differential	1. Describe the operation of a positive drive differential: (a) distinguish between three different types (b) state the basic principle of operation (c) describe a disassembly procedure and reassembly precautions (d) describe a testing procedure for positive traction differential
17. Recondition	1. Follow a reconditioning procedure in the proper sequence: (a) clean exterior thoroughly (b) record preload, backlash, gear runout and visible damage (c) inspect bearings (d) inspect gears for: (i) wear (ii) chipping (iii) scoring (iv) scuffing (e) remove bearing with proper tools and technique (f) preload pinion bearings while securing the pinion nut (g) preload side bearings using shims or adjusters (h) adjust backlash using shims or adjusters (i) take a gear contact pattern and readjust pinion or backlash to correct
SECTION THREE:	**DRIVE LINES** **6 HOURS**
A. Drive Lines	
	1. Distinguish between a torque tube and Hotchkiss drive: (a) differences in construction (b) differences in the way they compensate for length change 2. State how a drive line is balanced. 3. State the major types of universal joints: (a) ball and trunnion (b) cross and roller (c) constant velocity 4. State the function of each joint: (a) advantages (b) disadvantages (c) phasing (d) aligning 5. State the proper maintenance of universal joints. 6. Describe the operation of a slip yoke.

TOPIC	COURSE OBJECTIVES
	7. Describe the procedure for finding a faulty universal joint. 8. Describe a service and repair procedure for drive line joints: (a) precautions with constant velocity joints 9. Procedure in diagnosis of a faulty center support bearing. 10. Service and repair of front wheel drive axles.
SECTION FOUR:	**ELECTRICAL** **22 HOURS**
A. Overview	
	1. Recall basic circuit designs: (a) series (b) parallel (c) series parallel 2. Define volts, amps, ohms, and their characteristics. 3. Identify shorts, opens and grounds. 4. Apply all of the above to an automobile electrical system.
B. Ohm's Law	
	1. State Ohm's Law. 2. Apply Ohm's Law to simple circuits to find voltage: (a) to find amperage (b) to find resistance 3. Demonstrate the use of test gauges: (a) voltmeter (b) ammeter (c) ohmmeter 4. Interpret circuit diagrams and be able to determine appropriate current flow and voltage in different parts of series and parallel circuits given resistance and source voltage. 5. Recognize material as insulators or conductor and describe its function in the circuit. 6. Recognize and service protection units in the circuit: (a) fuses (b) fuseable link (c) circuit breaker 7. Describe the operation of each circuit protector. 8. Recognize the need for protection: (a) never by-pass a fuse (b) always use proper fuse

THIRD PERIOD TECHNICAL TRAINING
MOTOR MECHANIC
COURSE OUTLINE

SECTION ONE: **CHARGING SYSTEMS** **76 HOURS**

TOPIC

COURSE OBJECTIVES

Upon completion of this unit, the apprentice should be able to:

A. Electron Theory **6 Hours**

1. Explain the electron theory regarding current flow.
2. Understand the concept of voltage and how it is measured.
3. Understand the concept of current and how it is measured.
4. Understand the concept of resistance and how it is measured.
5. Recognize the relationship between voltage, current and resistance in a series circuit.
6. Understand parallel and series-parallel circuits.
7. Recognize voltage drop.

B. Magnetism **3 Hours**

1. Identify natural and man-made magnets.
2. Understand electromagnets and field strength.
3. Recognize the relationship between magnetic fields and conductors.
4. Recognize the principles of the electric motor.

C. Measuring Units and Instruments **9 Hours**

1. Understand analog meter construction and operation.
2. Understand ammeter construction.
3. Understand voltmeter construction.
4. Understand ohmmeter construction.
5. Demonstrate use of analog meter.
6. Use and read a digital multi-meter.

D. Circuits and Failures **6 Hours**

1. Identify shorts, opens and grounds in a simple circuit.
2. Test for shorts, opens and grounds in a simple circuit.
3. Identify and list electrical symbols used in automotive wiring diagrams.

E. Mechanical Components **9 Hours**

1. Principle of operation and function of a solenoid.
2. Principle of operation and function of switches.
3. Principles of operation and function of resistors and variable controls and relays.

F. Testing Procedures and Precautions **14 Hours**

1. Explain the operation and care of a multi-meter.
2. Connect a meter for testing charging system.

TOPIC	COURSE OBJECTIVES	
	3. Interpret faults in a charging system from meter readings. 4. Test for maximum output. 5. Interpret voltage limiter setting. 6. Test for voltage losses in the charging system.	
G. Batteries		**2 Hours**
	1. State the function and purpose of the battery. 2. Identify battery construction. 3. Understand battery classification and rating. 4. Discuss battery testing, charging and general service.	
H. Alternator		**21 Hours**
	1. State the purpose of the charging system. 2. Explain the operation of the alternator. 3. Explain the function of the alternator components. 4. Test alternator components. 5. Perform alternator repairs and service.	
I. Voltage Regulators		**6 Hours**
	1. Recognize types of regulators. 2. Understand the need for voltage regulation. 3. Understand the function and test a solid state regulator. 4. Trace the voltage regulator wiring circuit.	
SECTION TWO:	**CRANKING SYSTEMS**	**33 HOURS**
A. Motors		**12 Hours**
	1. Recognize cranking motor circuitry. 2. State the purpose of the starting system. 3. Understand starter motor operation. 4. Assemble and disassemble starters. 5. Service starter components. 6. Test starter components. 7. Diagnose and correct starter faults.	
B. Cranking System Drives		**3 Hours**
	1. List and describe types of starter drives. 2. Explain the operation of each type. 3. Identify provisions for weather proof operation. 4. Shim the starter for proper flywheel clearance. 5. Diagnose and test starter drives.	

TOPIC	COURSE OBJECTIVES	
C. Starter Switch Systems		**3 Hours**
	1. Identify starter control systems. 2. Understand function and operation of control components. 3. Discuss relation to the ignition system. 4. Recognize the need for safety provisions. 5. Discuss relation to battery condition. 6. Service starter solenoid. 7. Diagnose or test for faults in solenoid or relay.	
D. Recognition of Common Failures (Shop Only)		**7 Hours**
	1. Test for circuit failures such as shorts, opens and grounds. 2. Recognize damaged or worn starter drives. 3. Recognize starter armature damage. 4. Test circuit resistance. 5. Perform a starter draw test while cranking the engine. 6. Perform current draw tests with starter removed.	
E. Service Procedures and Precautions		**2 Hours**
	1. Recondition commutator bars using an armature lathe. 2. Install armature bushings. 3. Install snap rings in a safe manner.	
F. On Vehicle and Bench Diagnosis Procedures		**6 Hours**
	1. Visually inspect for proper assembly of electrical wiring. 2. Check for clean and proper battery connections. 3. Load test battery. 4. Perform battery drain test. 5. Determine state of charge of battery. 6. Perform cranking voltage test. 7. Determine starter draw. 8. Perform no-load test. 9. Measure and adjust starter drive to ring gear clearance.	
SECTION THREE:	**IGNITION SYSTEMS**	**49 HOURS**
A. Recognition of Types		**5 Hours**
	1. Understand the function of distributor points. 2. Explain the operation of distributor points. 3. Understand the function of electronic ignition. 4. Explain the operation of electronic ignition.	
B. Distributor		**6 Hours**
	1. Explain the operation of the distributor. 2. Test distributor components and circuits.	

TOPIC	COURSE OBJECTIVES
	3. Explain the function of each distributor component. 4. Interpret test procedures and specifications. 5. Understand operation of solid state ignition systems. 6. Explain operation of computer controlled ignition systems. 7. Diagnose and adjust as required. 8. Discuss cap designs.
C. Ignition Coil	**1 Hour**
	1. Explain function and principle of operation. 2. Test and diagnose for faulty operation. 3. Understand the need for proper coil polarity.
D. Spark Advance and Retard Systems	**3 Hours**
	1. Explain the need for vacuum and mechanical advance systems. 2. Understand operation of mechanical and vacuum advance systems. 3. Test centrifugal advance curve. 4. Test vacuum advance curve. 5. Test vacuum advance for leaks. 6. Make adjustments when required. 7. Understand importance of proper operation to meet Emission Standards.
E. High Tension Leads (Ignition)	**1 Hour**
	1. Understand the construction of ignition wires. 2. Explain the effect of insulation or the core break down. 3. Test resistance with an ohmmeter.
F. Ignition Switch	**3 Hours**
	1. Explain the basic function of and draw a simple primary circuit. 2. Explain the function of the switch for starter operation, security and accessory position. 3. Diagnose problems in the ignition switch circuit.
G. Spark Plugs	**2 Hours**
	1. Explain the function of the spark plugs. 2. Explain how spark plugs are classified and identified. 3. Determine if heat range is correct. 4. Clean, replace and test spark plugs. 5. Understand precautions required when replacing spark plugs.
H. Electronic Ignition Systems	**12 Hours**
	1. Understand operation of a solid state ignition system. 2. Recognize and state the purpose of the components. 3. Test and locate faulty components.

TOPIC	COURSE OBJECTIVES
I. Computer Ignition Systems	**16 Hours**
	1. Understand the principles of operation. 2. Recognize and state the purpose of components. 3. Diagnose computer controlled ignition systems by following the proper method. 4. Recognize hazards caused by improper testing procedures.
SECTION FOUR: **ALL-FUEL SYSTEMS**	**54 HOURS**
A. Fuels	**3 Hours**
	1. Understand the composition of fuels. 2. Understand the characteristics of fuels. 3. Discuss the function of additives. 4. Understand octane rating and the relation to engine design. 5. Understand and practice the safe handling and storage of fuel. 6. Recognize fuel emissions. 7. Recognize how temperature affects fuel. 8. Recognize the danger of open fuel lines when the carburetor is removed.
B. Fuel Tanks	**1 Hour**
	1. Understand structural details and the need for venting and baffles. 2. Trace connections to carbon cannister. 3. Recognize safe repair and draining procedures.
C. Fuel Pumps	**3 Hours**
	1. Recognize types and application. 2. Understand principles of operation. 3. Understand hazards when disconnecting fuel lines. 4. Test fuel pumps. 5. Diagnose problems in fuel pumps. 6. Understand the purpose of screens and filters. 7. Measure pressure before injector pump.
D. Fuel and Induction Systems	**2 Hours**
	1. Explain octane rating. 2. Understand relationship of fuel to engine design. 3. Recognize types and designs of intake manifolds. 4. State the functions of intake manifolds.
E. Carburetor	**21 Hours**
	1. List and explain the factors affecting carburetion. 2. Describe venturi principles of operation. 3. List the methods, and explain fuel metering control principles.

TOPIC COURSE OBJECTIVES

4. Explain the function of the carburetor.
5. Recognize and understand function of parts and components.
6. List the seven circuits in a modern carburetor.
7. Describe the function of the seven circuits.
8. Understand emission control devices and the effect on carburetion.
9. Diagnose faults related to carburetor circuits.
10. Understand relationship to engine condition and automatic transmission operation.
11. Understand the effect of the air cleaner and heat riser systems on the carburetor.
12. Perform all carburetor adjustments when reconditioning carburetor.

F. Gasoline Fuel Injection **24 Hours**

1. Understand the operation of throttle body injection systems.
2. Diagnose for proper operation of throttle body injection systems.
3. Understand the operation of port fuel injection systems.
4. Diagnose for proper operation of port fuel injection systems.
5. Understand operation of related components which control or monitor injection system.
6. List the advantages of fuel injection.

SECTION FIVE: TUNE-UP AND ACCESSORIES 28 HOURS

A. Testing Procedures

1. Perform cylinder balance test.
2. Test engine compression.
3. Perform cylinder leakage test.
4. Interpret vacuum gauge readings.
5. Analyse exhaust gases and interpret readings.

B. Attachment and Use of Scopes and Analyzers

1. Interpret scope patterns and readings.
2. Recognize faults in all parts of the ignition system by using the scope.
3. Adjust ignition and fuel system to specifications.

C. Relationship of Engine Performance to Drive Train Units

1. Understand how engine performance affects automatic transmission operation.
2. Understand how differential gear ratio affects performance.

D. Emission Control Systems

1. List the major pollutants emitted by the automobile.
2. Explain the sources of pollutants from the automobile.
3. Describe the effects these pollutants have on the environment.
4. Explain the methods used to measure concentrations of these pollutants.

TOPIC	COURSE OBJECTIVES
	5. Explain the operation of, name the components of, list pollutants controlled and diagnose malfunctions in the following emission control systems: (a) fuel tank venting (b) charcoal canisters (c) positive crankcase ventilation (PCV) (d) air injection (e) catalytic converters (f) exhaust gas recirculation (EGR) (g) computerized
	6. Use and read vacuum hose routing schematic.
E. Interrelationship of Engine Tune and Other Systems	
	1. Comprehend the effect of engine temperature on an improperly tuned engine.
	2. Understand how excessive fuel affects the lubrication system.
	3. Diagnose effect of improperly tuned engine on cooling and lubrication systems.
	4. Diagnose a restricted exhaust system.
F. Reading Circuit Diagrams	
	1. Trace path of power in circuit diagrams.
	2. Identify automotive electrical symbols.
G. Engine Service Indicator System	
	1. Understand the operation of temperature, oil pressure and fuel gauges.
	2. Understand the operation of the charging system gauge or light.
	3. Diagnose an inoperative charging system gauge or light.
	4. Repair an inoperative charging system gauge or light.
H. Horns	
	1. Test and locate defective horn or circuit.
I. Traffic Signal Indicators	
	1. Trace electrical circuit for signal light operation.
	2. Diagnose defects in signal light circuits and components.
	3. Understand how signal and brake lights are interconnected.
J. Warning Indicators	
	1. Understand operation and repair defects in brake warning systems.
	2. Test and repair defects in the hand brake warning light.
	3. Test and repair faults in seat belt warning indicators.
K. Headlight Systems	
	1. Understand the operation of two and four unit headlight systems.
	2. Properly aim headlight systems.
	3. Diagnose and repair faults in the headlight circuits.

TOPIC	COURSE OBJECTIVES
L. Parking and Brake Light Systems	
	1. Explain principles of operation of parking and brake light systems.
	2. Diagnose faults in parking and brake light systems.
M. Windshield Wiper and Washer Mechanisms	
	1. Identify types and designs.
	2. Understand operating principles.
	3. Understand how motor speed is regulated.
	4. Diagnose faults in circuits.
N. Rear Window Defrosters and Defoggers	
	1. Understand principles of operation.
	2. Test and repair faults.
O. Power Seat Adjusting Systems	
	1. Understand principles of operation.
	2. Test and repair faults.
P. Power Windows and Door Locks	
	1. Understand principles of operation.
	2. Test and repair faults.
Q. Automatic Speed Control Systems	
	1. Understand principles of operation.
	2. Test and repair faults.

FOURTH PERIOD TECHNICAL TRAINING
MOTOR MECHANIC
COURSE OUTLINE

SECTION ONE: **AUTOMATIC TRANSMISSIONS** **160 HOURS**

TOPIC

COURSE OBJECTIVES

Upon completion of this unit, the apprentice should be able to:

A. Basic Applications of Scientific Principles **9 Hours**

1. Recognize the hydraulic principle.
2. Define friction.
3. Recognize the lever actions.
4. Explain the purposes of tranmission fluid.
5. List the types of fluids in use and their application.
6. List the qualities of transmission fluid.
7. Demonstrate how to use fluid as an indicator of transmission condition.
8. Define torque.

B. Planetary Gear Applications **35 Hours**

1. State the purpose of a planetary gear set.
2. List the advantages of using planetary gears.
3. List the functions of a planetary gear set.
4. Name the parts required to construct a simple planetary gear set.
5. Describe principles of compound gear sets.
6. Describe planetary gear set construction.
7. List the methods used to retain the pinion shaft in the pinion carrier.
8. Explain how friction between the pinions and the pinion shafts is reduced to a minimum.
9. List the member held, the drive member, and the member driven to obtain all possible forward or reverse speeds in a planetary gear set.
10. Describe two methods of obtaining direct drive from a planetary gear set.
11. List possible causes of tooth breakage in a planetary gear set.
12. List conditions that occur in a planetary gear set if the gear set has broken teeth.
13. List conditions that would render planetary gears unfit for further use.
14. Check the gear ratio of a simple planetary gear set.

C. Torque Converters **18 Hours**

1. State the purpose of a torque converter.
2. Name the parts of a torque converter.
3. Explain the operation of a torque converter.
4. State the purpose of the turbine in a torque converter.
5. State when maximum torque multiplication is obtained from a torque converter.

TOPIC	COURSE OBJECTIVES
	6. State the purpose and operation of the lock-up torque converter. 7. List the failures that can occur in a torque converter. 8. Understand the effect on transmission operation when torque converter failure occurs. 9. List the precautions when removing or installing a torque converter.
D. Governors	**6 Hours**
	1. Describe the operation of the governor. 2. State the function of the governor. 3. Trace the oil flow through the governor. 4. Diagnose faults that can occur in the governor. 5. Test governor pressure. 6. Check and service governors (if applicable).
E. Valves	**20 Hours**
	1. Throttle Valve: (a) State the purpose of a throttle valve. (b) List two methods used to operate the throttle valve. (c) Determine if valve is balanced or unbalanced. (d) List two places where the exhaust port can be positioned. (e) State why oil pressure is present on one area and opposing spring pressure on another area. (f) Trace the input oil passages, the outlet oil passages and the exhaust port from a given illustration. (g) Describe how a variable oil pressure, from zero to full main line circuit oil pressure, is obtained from a throttle valve from a given illustration. (h) List two purposes of throttle valve oil pressure. (i) List two conditions that will occur if a throttle valve sticks in a position where the valve exhaust port is always blocked off. (j) Describe two conditions that will occur if a spring having a greater tension than the original is installed into a throttle valve. (k) Describe two conditions that will be apparent in a unit using a vacuum control to operate the throttle valve in a situation where the vacuum control diaphragm is broken. 2. Shift valves: (a) State the purpose of a shift valve. (b) Trace the oil pressure feed line to the shift valve when the valve is in a closed position. (c) Trace the oil pressure flow through the shift valve when the valve is in an open position from a given illustration. (d) State how the shift valve is normally held in a closed position. (e) List two oil pressures that are used to ensure that the shift valve moves very quickly from a closed position to an open position. (f) Explain how shift valve hunt is prevented when the shift valve moves from a closed position to an open position. (g) Explain how a shift valve can be forced closed from an open position by fully depressing the accelerator pedal. (h) State how a shift valve moves to a closed position when the vehicle is coasting to a stop. (i) Explain how transmission operation will be affected if a shift valve fails to move from a closed position to an open position. (j) State how transmission operation will be affected if a shift valve remains in the open position at all times.

(k) Explain how a stuck shift valve can be removed from its bore.
(l) Explain the procedure involved to clean up the bore in which a shift valve moves.
(m) Explain how a burr is removed from a valve spool.
(n) List the things that could be responsible if a shift valve is found to be stuck in the bore.

3. Manual valves:
   (a) State the purpose of the manual valve.
   (b) Explain the result of faulty installation of a manual valve.
   (c) Trace oil circuits through a manual valve.
4. Other valves:
   (a) State the purpose of the vacuum modulator and valve.
   (b) List two types of vacuum modulators.
   (c) List conditions that will affect transmission operation if the vacuum modulator diaphragm is broken or porous.
   (d) State the purpose of a torque converter oil pressure control valve.
   (e) List the condition that will occur if the torque converter oil pressure control valve sticks in such a position that no oil pressure can return from the torque converter.
5. Pressure regulator valve:
   (a) State the purpose of the pressure regulator valve.
   (b) Determine if the pressure regulator is a balanced valve.
   (c) Determine the number of reaction areas from a given illustration.
   (d) Explain how a pressure regulator valve moves to a position which allows surplus oil pressure to be exhausted.
   (e) Describe how oil pressure regulation is accomplished.
   (f) List the methods that are used to obtain modulated oil pressure regulation according to throttle opening, in pressure regulation systems that do not use a vacuum control.
   (g) Describe how a modulated oil pressure is obtained in a system that uses a vacuum control to modulate the main line circuit oil pressure.
   (h) List the methods used to obtain increased hydraulic circuit oil pressure when a reverse selection is made.
   (i) State the function of a boost valve.

F. Clutches and Bands **14 Hours**

1. State the purpose of a multiple disc clutch.
2. Name the parts of a multiple disc clutch.
3. List the methods used to release or apply the clutch.
4. State the purpose of the clutch piston seals.
5. State the purpose of the clutch relief valve and the location of the valve.
6. State the purpose of the air relief valve.
7. Explain why cushioning devices are used in multiple disc clutches.
8. List two types of cushioning devices commonly found in clutch assemblies.
9. Demonstrate methods used to prevent clutch piston seal damage during clutch piston installation.
10. Determine if clutch plates are flat, wavy or concave.
11. List plate conditions that would render the friction or steel plates in a clutch assembly to be unfit for further use.
12. Properly assemble the clutch unit and determine proper clearance.

13. Trace oil passage into the clutch.
14. List causes of clutch slippage.
15. Locate defects in a clutch drum.
16. State the purpose of a band.
17. List the friction facings used on a band.
18. Name the methods used to attack the friction facings to the band.
19. Describe how a band is applied and released.
20. List conditions which would render a band unfit for further service.
21. List the methods of adjusting a band.

G. Oil Pumps **5 Hours**

1. State the function of the oil pump.
2. Name the parts in an oil pump and state their purpose.
3. Describe the operation of a typical fixed and variable capacity pump.
4. List the conditions or tests which would render the pump unfit for further service.
5. State the purpose of the cooler bypass valve found in some pump assemblies.

H. Modulators **3 Hours**

1. State the purpose of a vacuum modulator.
2. List the types of vacuum modulators.
3. List the effect of modulator failure.

I. Hydraulic Circuits **15 Hours**

1. Trace the flow of oil in a transmission using a circuit diagram as a guide.
2. Recognize basic oil circuits found in a modern automatic transmission.
3. Determine the interrelationship of oil circuits and the effect on other circuits.

J. Removal and Installation Procedures and Precautions **4 Hours**

1. Follow safe removal and installation procedures and precautions.
2. Perform final pressure test and adjustment.
3. Test transmission operation and verify its correct operation.

K. Disassembly and Reassembly Procedures **15 Hours**

1. Perform pressure tests and diagnose failure in transmissions.
2. Dismantle transmission using approved methods.
3. Measure end play with approved service manual procedures.
4. Identify and determine serviceability of parts.
5. Assemble and adjust transmission with approved service manual procedures.

TOPIC	COURSE OBJECTIVES
L. Transaxles (Front Wheel Drive)	**16 Hours**
	1. Identify types of transaxles. 2. Trace the path of power through a transaxle. 3. Identify the parts of a transaxle. 4. Remove transaxle using approved method. 5. Dismantle transaxle. 6. Determine serviceability of parts. 7. Assemble transaxle. 8. Test operation and pressure test transaxle. 9. Make service adjustments. 10. Identify service precautions.
SECTION TWO: **AIR CONDITIONING**	**30 HOURS**
A. Air Conditioning	
	1. Describe types of heat movement. 2. Relate latent heat to condensation and evaporation. 3. Describe how heat affects states of matter. 4. List the properties, composition and measurement methods of R12. 5. Describe how pressure/temperature affects the state of R12. 6. List the rules of safety and precautions when handling and storing R12. 7. State the purpose, and method of handling refrigerant oil. 8. Name and state the function of each component. 9. Demonstrate the correct procedure for leak testing. 10. Identify service valve types. 11. Safely discharge, evacuate and recharge an A/C system. 12. Locate problems in the refrigerant system using test equipment. 13. Identify controls and relate their function to the total system. 14. Demonstrate the proper method of locating a malfunction in the control system. 15. Explain the approved method of component repair or replacement. 16. Identify factory equipment and compare its operation and controls to an after market system. 17. Describe how A/C affects other components in the automobile (i.e. cooling system, etc.).
SECTION THREE: **SPECIAL OPTIONS**	**14 HOURS**
A. New Developments in the Industry	
	1. Provide introduction to product training and diagnostic procedures for new developments such as electronic and computer systems.

TOPIC COURSE OBJECTIVES

SECTION FOUR: FUEL SYSTEMS 26 HOURS

A. Fuel Injection System (Diesel) 20 Hours

1. Describe the major properties of diesel fuel.
2. Identify cetane ratings.
3. Identify and describe the function of the primary fuel system.
4. Explain primary fuel system test procedures — service intervals.
5. Identify and explain basic operating principles of currently used injector pumps.
6. Explain the basic operating principles of governors and advance mechanisms.
7. Identify currently used injector types and explain their operation.
8. Demonstrate approved injector testing procedure and the safety precautions involved.
9. Demonstrate approved injector service procedures.
10. Identify types of currently used glow plugs and explain their purpose.
11. Explain the approved methods and precautions in testing the operation of glow plugs.
12. Explain "on vehicle" maintenance, approved testing and adjustment procedures.

B. Liquified Petroleum and Natural Gas Fuel Systems 6 Hours

1. Principles of operation and codes.
2. Recognize and understand the function of the components.
3. Understand hazards related to the systems.
4. Understand safety requirements and safe handling of fuels.

SECTION FIVE: REVIEW 10 HOURS

A. Review of material covered in previous years of apprenticeship training.

SUGGESTED REFERENCE MATERIALS

Auto Mechanics Fundamentals — Stockel — Goodheart — Wilcox — Latest Edition

Auto Service and Repairs — Stockel — Goodheart — Wilcox — Latest Edition

Workbook for Auto Service and Repair by Stockel — Duffy

Automotive Electrical Systems — Ellinger — Prentice Hall — Latest Edition

Automotive Electrical Systems — Check Chart

Motors Automatic Transmission — Ritchen — Latest Edition

Automotive Basic Service Air Conditioning Service Manual — Mitchel — Latest Edition

Automatic Transmissions — Brejcka — Latest Edition

TECHNICAL TRAINING SCHOOLS

The Motor Mechanic apprenticeship training program is offered by Alberta Career Development and Employment, Apprenticeship and Trade Certification. Staff and facilities for teaching the program are supplied by:

1. Northern Alberta Institute of Technology
2. Southern Alberta Institute of Technology
3. Medicine Hat College
4. Red Deer College
5. Lethbridge Community College
6. Lakeland College
7. Keyano College
8. Fairview College

LOCATION OF APPRENTICESHIP AND TRADE CERTIFICATION REGIONAL OFFICES

BONNYVILLE

CALGARY

EDMONTON

FORT McMURRAY

GRANDE PRAIRIE

HINTON

LETHBRIDGE

MEDICINE HAT

PEACE RIVER

RED DEER

VERMILION

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